



## Outdoor luminescence imaging strategies for drone-based PV array inspection

**Benatto, Gisele Alves dos Reis; Riedel, Nicholas; Mantel, Claire; Thorsteinsson, Sune; Poulsen, Peter Behrendorff; Forchhammer, Søren; H. B. Frederiksen, Kenn; Vedde, Jan; Parikh, Harsh; Spataru, Sergiu**

*Total number of authors:*  
11

*Published in:*  
Book of Abstracts Sustain 2017

*Publication date:*  
2017

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

### *Citation (APA):*

Benatto, G. A. D. R., Riedel, N., Mantel, C., Thorsteinsson, S., Poulsen, P. B., Forchhammer, S., H. B. Frederiksen, K., Vedde, J., Parikh, H., Spataru, S., & Sera, D. (2017). Outdoor luminescence imaging strategies for drone-based PV array inspection. In *Book of Abstracts Sustain 2017* [D-6]

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## Outdoor luminescence imaging strategies for drone-based PV array inspection

Gisele A. dos Reis Benatto<sup>1\*</sup>, Nicholas Riedel<sup>1</sup>, Claire Mantel<sup>1</sup>, Sune Thorsteinsson<sup>1</sup>, Peter B. Poulsen<sup>1</sup>, Søren Forchhammer<sup>1</sup>, Kenn H. B. Frederiksen<sup>2</sup>, Jan Vedde<sup>3</sup>, Harsh Parikh<sup>4</sup>, Sergiu Spataru<sup>4</sup> and Dezso Sera<sup>4</sup>

1: Department of Photonics Engineering, Technical University of Denmark, Frederiksborgvej 399, 4000, Roskilde, Denmark

2: Kenergy, Grønningen 43, 8700, Horsens, Denmark

3: SiCon Silicon & PV consulting, J N Vinthersvej 5, 3460, Birkerød, Denmark

4: Aalborg University, Pontoppidanstraede 101, 9220, Aalborg, Denmark

\*Corresponding author email: garb@fotonik.dtu.dk

Regular fault detection for effective maintenance is highly important to ensure expected return on investment (ROI) of small and large-scale photovoltaic (PV) installations. Present day PV panels are designed to operate for 25-30 years, however field experience shows that after 11-12 years of operation, 2% or more of all PV panels fail [1].

In practice, the frequency and inspection detail level is often limited by manpower and cost. Presently, drone-based infrared (IR) thermography inspection of solar plants is a reality [2], [3]. The accuracy of thermographic fault detection though, presents limitations – primarily related to deconvoluting the failure signature into failure type and severity, which can be overcome when performed in combination to electro-(EL) or photo-(PL) luminescence imaging of the panels. The combination of defect detection techniques has been already tested in laboratory [1], [4], although many limitations still need to be addressed in order to obtain image acquisition outdoors and integrate, automate and optimize the imaging system in a drone. The concept of PL/EL in a drone is illustrated in Fig. 1.

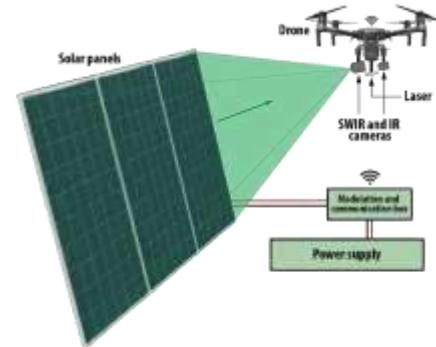


Fig. 1. Concept of automated drone inspection.

In this work, we present the results corresponding to the development of two luminescence-imaging strategies for PV modules defect detection in outdoor conditions, with the aim of choosing the most suitable method for implementation on a drone-based PV plant inspection system.

- [1] M. Köntges *et al.*, "Review of Failures of Photovoltaic Modules," *IEA-Photovoltaic Power Syst. Program.*, pp. 1–140, 2014.
- [2] S. Dotenco *et al.*, "Automatic detection and analysis of photovoltaic modules in aerial infrared imagery," *2016 IEEE Winter Conf. Appl. Comput. Vis.*, pp. 1–9, 2016.
- [3] D. Kint and S. Muñoz-Guerra, "A review on the potential biodegradability of poly(ethylene terephthalate)," *Polym. Int.*, vol. 48, no. 5, pp. 346–352, May 1999.
- [4] S. Johnston and T. Silverman, "Photoluminescence and Electroluminescence Imaging Workstation," *NREL*, 2015.